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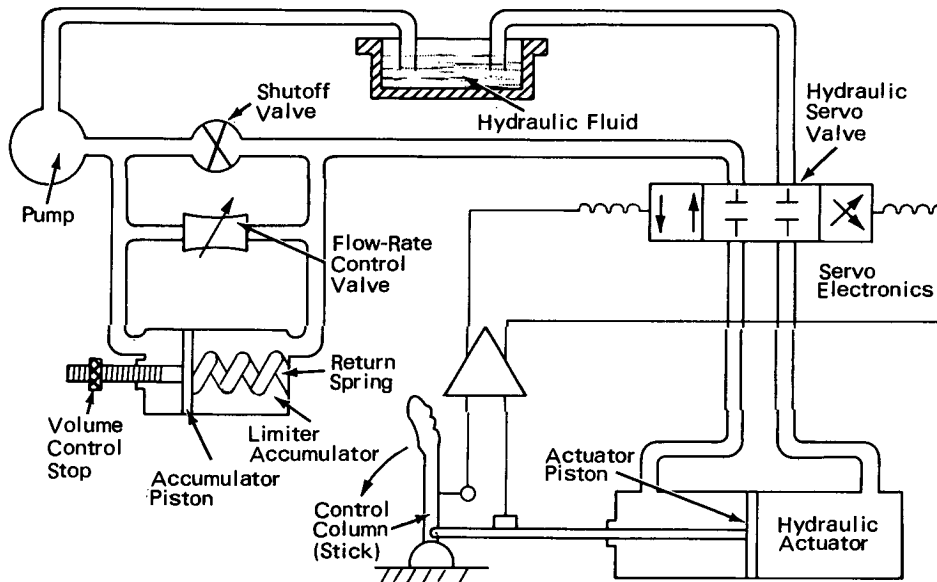
Hydraulic Actuator Motion Limiter Ensures Operator Safety

The problem:

To eliminate possible operator injury from the control column in an aircraft simulator. In standard practice, the control column is loaded by an hy-

How it's done:

The motion of the column is regulated in two consecutive intervals: (1) initial swing-limiting (10 to 20% of the full column swing) at maximum (full



draulically actuated servo system to provide the operator with a realistic feel of column reaction in an actual aircraft. However, in the event that a large step function or a hard-over signal is applied by the servo system, the control column may be slammed toward the operator with sufficient energy to injure him.

The solution:

A motion limiter that regulates the action of the hydraulic linkage to the control column in order to minimize the hazard to the operator. The primary components of the device (see fig.) are the flow-rate control valve, the limiter accumulator, and the shutoff valve.

system performance) rate; and (2) reduced column-motion rate until the column (or actuator piston) reaches its extreme position. This mode of regulation provides effective control-column sensing by the operator in all but the most critical situations. The limiter can be easily bypassed whenever desired by opening the shutoff valve.

To operate the system, the shutoff valve is closed, allowing the pump to force hydraulic fluid through the flow-rate valve and the limiter accumulator. For all normal demands on the system, sufficient flow can be provided by adjusting the flow-rate control valve. However, when large (greater than normal) flow rate demands are made on the system, the

(continued overleaf)

flow rate is basically regulated by the limiter accumulator. Over the first 10 to 20% of the full control-column swing (at maximum rate), the accumulator piston moves at full rate into the accumulator cylinder until the volume-control stop strikes the end of the cylinder. At this instant, any further motion of the hydraulic actuator piston (or control column) is effected by fluid metered at a relatively slow rate through the flow-rate control valve. When the demand for greater than normal flow rate ceases and the actuator piston (or control column) returns to its neutral position, a spring returns the accumulator piston to its ready or loaded condition.

Notes:

1. The motion limiter may be readily incorporated into other hydraulic systems to prevent undue wear on hydraulic actuators and associated components.

2. No additional documentation is available. Specific questions, however, may be directed to:

Technology Utilization Officer
Ames Research Center
Moffett Field, California 94035
Reference: B71-10233

Patent status:

This invention has been patented by NASA (U.S. Patent No. 3,568,572), and royalty-free license rights will be granted for its commercial development. Inquiries about obtaining a license should be addressed to:

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